

PERIODIC TABLE

A grid-in response area consisting of three columns of bubbles. The first column has 10 bubbles, the second has 10 bubbles, and the third has 10 bubbles. A dashed line indicates the starting point for the first column.

Ion Sheet

Positive Oxidation Numbers of Metallic Ions

1+		2+				3+			
cesium	Cs ¹⁺	barium	Ba ²⁺	manganese(II)	Mn ²⁺	aluminum	Al ³⁺	gold(III)	Au ³⁺
copper(I)	Cu ¹⁺	beryllium	Be ²⁺	mercury(II)	Hg ²⁺	antimony(III)	Sb ³⁺	indium(III)	In ³⁺
gold(I)	Au ¹⁺	cadmium	Cd ²⁺	nickel(II)	Ni ²⁺	bismuth(III)	Bi ³⁺	iron(III)	Fe ³⁺
hydrogen	H ¹⁺	calcium	Ca ²⁺	platinum(II)	Pt ²⁺	cerium(III)	Ce ³⁺	manganese(III)	Mn ³⁺
indium(I)	In ¹⁺	chromium(II)	Cr ²⁺	strontium	Sr ²⁺	cobalt(III)	Co ³⁺	nickel(III)	Ni ³⁺
lithium	Li ¹⁺	cobalt(II)	Co ²⁺	tin(II)	Sn ²⁺	chromium(III)	Cr ³⁺	thallium(III)	Tl ³⁺
potassium	K ¹⁺	copper(II)	Cu ²⁺	titanium(II)	Ti ²⁺	gallium(III)	Ga ³⁺	titanium(III)	Ti ³⁺
rubidium	Rb ¹⁺	germanium(II)	Ge ²⁺	tungsten(II)	W ²⁺			vanadium(III)	V ³⁺
silver	Ag ¹⁺	iron(II)	Fe ²⁺	vanadium(II)	V ²⁺				
sodium	Na ¹⁺	lead(II)	Pb ²⁺	zinc	Zn ²⁺				
thallium(I)	Tl ¹⁺	magnesium	Mg ²⁺	zirconium(II)	Zr ²⁺				

4+		5+		6+		7+	
cerium(IV)	Ce ⁴⁺	titanium(IV)	Ti ⁴⁺	antimony(V)	Sb ⁵⁺	chromium(VI)	Cr ⁶⁺
germanium(IV)	Ge ⁴⁺	tungsten(IV)	W ⁴⁺	bismuth(V)	Bi ⁵⁺	tungsten(VI)	W ⁶⁺
lead(IV)	Pb ⁴⁺	uranium(IV)	U ⁴⁺	tungsten(V)	W ⁵⁺		
manganese(IV)	Mn ⁴⁺	vanadium(IV)	V ⁴⁺	uranium(V)	U ⁵⁺		
platinum(IV)	Pt ⁴⁺	zirconium(IV)	Zr ⁴⁺	vanadium(V)	V ⁵⁺		
tin(IV)	Sn ⁴⁺						

Charges of Common Polyatomic Ions

1-				2-		3-	
acetate	C ₂ H ₃ O ₂ ¹⁻	hypochlorite	ClO ¹⁻	carbonate	CO ₃ ²⁻	arsenate	AsO ₄ ³⁻
azide	N ₃ ¹⁻	hypofluorite	FO ¹⁻	chromate	CrO ₄ ²⁻	arsenite	AsO ₃ ³⁻
bromate	BrO ₃ ¹⁻	hypoiodite	IO ¹⁻	dichromate	Cr ₂ O ₇ ²⁻	citrate	C ₆ H ₅ O ₇ ³⁻
bromite	BrO ₂ ¹⁻	hypophosphite	PH ₂ O ₂ ¹⁻	hydrogen phosphate	HPO ₄ ²⁻	phosphate	PO ₄ ³⁻
chlorate	ClO ₃ ¹⁻	iodate	IO ₃ ¹⁻	molybdate	MoO ₄ ²⁻		
chlorite	ClO ₂ ¹⁻	iodite	IO ₂ ¹⁻	oxalate	C ₂ O ₄ ²⁻		
cyanate	OCN ¹⁻	metaphosphate	PO ₃ ¹⁻	peroxide	O ₂ ²⁻	4-	
cyanide	CN ¹⁻	nitrate	NO ₃ ¹⁻	peroxydisulfate	S ₂ O ₈ ²⁻	pyrophosphate	P ₂ O ₇ ⁴⁻
dihydrogen phosphate	H ₂ PO ₄ ¹⁻	nitrite	NO ₂ ¹⁻	selenate	SeO ₄ ²⁻		
fluorate	FO ₃ ¹⁻	perbromate	BrO ₄ ¹⁻	silicate	SiO ₃ ²⁻	1+	
fluorite	FO ₂ ¹⁻	perchlorate	ClO ₄ ¹⁻	sulfate	SO ₄ ²⁻	ammonium	NH ₄ ¹⁺
formate	HCO ₂ ¹⁻	perfluorate	FO ₄ ¹⁻	sulfite	SO ₃ ²⁻		
hydrogen carbonate	HCO ₃ ¹⁻	periodate	IO ₄ ¹⁻	tartrate	C ₄ H ₄ O ₆ ²⁻	2+	
hydrogen sulfate	HSO ₄ ¹⁻	permanganate	MnO ₄ ¹⁻	tellurate	TeO ₄ ²⁻	mercury(I)	Hg ₂ ²⁺
hydrogen sulfite	HSO ₃ ¹⁻	peroxyborate	BO ₃ ¹⁻	tetraborate	B ₄ O ₇ ²⁻		
hydroxide	OH ¹⁻	thiocyanate	SCN ¹⁻	thiosulfate	S ₂ O ₃ ²⁻		
hypobromite	BrO ¹⁻			tungstate	WO ₄ ²⁻		

Ion Sheet

Positive Oxidation Numbers of Non-Metallic Elements					
1+		2+		3+	
nitrogen(I)	N ¹⁺	carbon(II)	C ²⁺	arsenic(III)	As ³⁺
		nitrogen(II)	N ²⁺	boron	B ³⁺
		silicon(II)	Si ²⁺	nitrogen(III)	N ³⁺
				phosphorus(III)	P ³⁺
4+		5+		6+	
carbon(IV)	C ⁴⁺	arsenic(V)	As ⁵⁺	selenium(VI)	Se ⁶⁺
nitrogen(IV)	N ⁴⁺	nitrogen(V)	N ⁵⁺	sulfur(VI)	S ⁶⁺
selenium(IV)	Se ⁴⁺	phosphorus(V)	P ⁵⁺	tellurium(VI)	Te ⁶⁺
silicon(IV)	Si ⁴⁺				
sulfur(IV)	S ⁴⁺				
tellurium(IV)	Te ⁴⁺				

Negative Oxidation Numbers of Non-Metallic Ions					
1-		2-		3-	
bromide	Br ¹⁻	oxide	O ²⁻	nitride	N ³⁻
chloride	Cl ¹⁻	selenide	Se ²⁻	phosphide	P ³⁻
fluoride	F ¹⁻	sulfide	S ²⁻		
hydride	H ¹⁻	telluride	Te ²⁻		
iodide	I ¹⁻				
					4-
					carbide

<u>Per-ate</u>	<u>-ate</u>	<u>-ite</u>	<u>hypo-ite</u>	<u>-ide</u>
ClO ₄ ⁻¹	ClO ₃ ⁻¹	ClO ₂ ⁻¹	ClO ⁻¹	Cl ⁻¹
PO ₅ ⁻³	PO ₄ ⁻³	PO ₃ ⁻³	PO ₂ ⁻³	P ⁻³
SO ₅ ⁻²	SO ₄ ⁻²	SO ₃ ⁻²	SO ₂ ⁻²	S ⁻²
CO ₄ ⁻²	CO ₃ ⁻²	CO ₂ ⁻²	CO ⁻²	C ⁻⁴
NO ₄ ⁻¹	NO ₃ ⁻¹	NO ₂ ⁻¹	NO ⁻¹	N ⁻³

<u>Per-ate</u>	<u>-ate</u>	<u>-ite</u>	<u>hypo-ite</u>	<u>-ide</u>
ClO_4^{-1}	ClO_3^{-1}	ClO_2^{-1}	ClO^{-1}	Cl^{-1}
PO_5^{-3}	PO_4^{-3}	PO_3^{-3}	PO_2^{-3}	P^{-3}
SO_5^{-2}	SO_4^{-2}	SO_3^{-2}	SO_2^{-2}	S^{-2}
CO_4^{-2}	CO_3^{-2}	CO_2^{-2}	CO^{-2}	C^{-4}
NO_4^{-1}	NO_3^{-1}	NO_2^{-1}	NO^{-1}	N^{-3}

+1 Ions ↓	+2 Ions ↓	+3 Ions ↓	+4 Ions ↓
Cu ⁺¹ - Cuprous Hg ⁺¹ - Mercurous Ag ⁺¹ Au ⁺¹ H ⁺¹ NH ₄ ⁺¹ - Ammonium <u>Row 1A in Periodic Table</u>	Cu ⁺² - Cupric Hg ⁺² - Mercuric Fe ⁺² - Ferrous Sn ⁺² - Stannous Cd ⁺² Co ⁺² Pb ⁺² Mn ⁺² Ni ⁺² Zn ⁺² <u>Row 2A in Periodic table</u>	Fe ⁺³ - Ferric Bi ⁺³ Cr ⁺³ Ga ⁺³ Ce ⁺³	Sn ⁺⁴ - Stannic Ge ⁺⁴ Th ⁺⁴ Zr ⁺⁴
-1 Ions ↓	-2 Ions ↓	-3 Ions ↓	-4 Ions ↓
C ₂ H ₃ O ₂ ⁻¹ - Acetate N ₃ ⁻¹ - Azide HCO ₃ ⁻¹ - Bicarbonate (hydrogen-) HSO ₃ ⁻¹ - Bisulfite (hydrogen-) HSO ₄ ⁻¹ - Bisulfate (hydrogen-) BrO ₃ ⁻¹ - Bromate ClO ₃ ⁻¹ - Chlorate ClO ₂ ⁻¹ - Chlorite OCN ⁻¹ - Cyanate CN ⁻¹ - Cyanide HCO ₂ ⁻¹ - Formate OH ⁻¹ - Hydroxide ClO ⁻¹ - Hypochlorite IO ₃ ⁻¹ - Iodate NO ₃ ⁻¹ - Nitrate NO ₂ ⁻¹ - Nitrite BrO ₄ ⁻¹ - Perbromate ClO ₄ ⁻¹ - Perchlorate MnO ₄ ⁻¹ - Permanganate SCN ⁻¹ - Thiocyanate <u>Row 7A Non-metals in Periodic Table</u>	CO ₃ ⁻² - Carbonate CrO ₄ ⁻² - Chromate Cr ₂ O ₇ ⁻² - Dichromate HPO ₄ ⁻² - Biphosphate (hydrogen-) C ₂ O ₄ ⁻² - Oxalate O ₂ ⁻² - Peroxide SiO ₃ ⁻² - Silicate SO ₄ ⁻² - Sulfate SO ₃ ⁻² - Sulfite C ₄ H ₄ O ₆ ⁻² - Tartrate S ₂ O ₃ ⁻² - Thiosulfate WO ₄ ⁻² - Tungstate	AsO ₄ ⁻³ - Arsenate AsO ₃ ⁻³ - Arsenite PO ₄ ⁻³ - Phosphate	P ₂ O ₇ ⁻⁴ - Pyrophosphate
<u>Row 6A Non-metals in Periodic Table</u>	<u>Row 5A Non-metals in Periodic Table</u>		

Maximum Positive Charge of Element = Group # (They tend to be all even or odd values - Example Cl⁺⁷, Cl⁺⁵, Cl⁺³, Cl⁺¹)
 Negative Charge of Element = Group # - 8 (Non-Metals Only)

↓ Lowest Charge of Non-Metal to Highest Charge of Non-Metal ↓
 Naming System for multiple Charge ions (Hypo- name - ite) (name - ite) (name - ate) (Per- name - ate)

DO NOT DETACH FROM BOOK.

1	H	1.0079	2	He	4.0026
3	Li	6.941	9	F	19.00
11	Na	22.99	17	Cl	35.453
19	K	39.10	25	Mn	54.938
27	Rb	85.47	33	As	74.92
35	Sr	87.62	41	Nb	92.91
53	Cs	132.91	51	Sb	121.75
87	Fr	223	85	At	(210)
4	Be	9.012	12	Mg	24.30
10	Ne	20.179	18	Ar	39.948
16	O	16.00	24	Cr	52.00
22	Ca	40.08	30	Zn	65.39
28	Ni	58.69	36	Kr	83.80
34	Se	78.96	40	Zr	91.22
40	Y	88.91	46	Mo	95.94
46	*La	138.91	52	Te	127.60
54	Ba	137.33	60	Pb	207.2
82	Ra	226.02	80	Hg	200.59
88	Ac	227.03	86	Po	(209)
90	Th	232.04	92	U	238.03
94	Pa	231.04	98	Cf	(251)
100	U	238.03	104	Lr	(260)
102	Np	237.04	106	La	138.91
104	Pu	244.06	108	Ce	140.12
106	Am	243.06	110	Pr	140.91
108	Cm	247.07	112	Nd	144.24
110	Bk	247.07	114	Pm	(145)
112	Cf	251.08	116	Sm	150.36
114	Es	252.08	118	Eu	151.96
116	Fm	257.10	120	Gd	157.92
118	Mn	54.938	122	Tb	158.93
120	Co	58.93	124	Dy	162.50
122	Ni	58.69	126	Ho	164.93
124	Cu	63.55	128	Er	167.26
126	Zn	65.39	130	Tm	168.93
128	Ga	69.72	132	Yb	173.05
130	Ge	72.59	134	Lu	174.97
132	As	74.92	136	Hf	178.49
134	Se	78.96	138	Ta	180.95
136	Br	79.90	140	W	183.85
138	Kr	83.80	142	Re	186.21
140	Sr	87.62	144	Os	190.2
142	Rb	85.47	146	Ir	192.2
144	Sr	87.62	148	Pt	195.08
146	K	39.10	150	Au	196.97
148	Ca	40.08	152	Hg	200.59
150	Sc	44.96	154	Tl	204.38
152	Ti	47.90	156	Pb	207.2
154	V	50.94	158	Bi	208.98
156	Cr	52.00	160	Po	(209)
158	Mn	54.938	162	At	(210)
160	Fe	55.85	164	Rn	(222)
162	Co	58.93	166		
164	Ni	58.69	168		
166	Cu	63.55	170		
168	Zn	65.39	172		
170	Ga	69.72	174		
172	Ge	72.59	176		
174	As	74.92	178		
176	Se	78.96	180		
178	Br	79.90	182		
180	Kr	83.80	184		
182	Sr	87.62	186		
184	Rb	85.47	188		
186	K	39.10	190		
188	Ca	40.08	192		
190	Sc	44.96	194		
192	Ti	47.90	196		
194	V	50.94	198		
196	Cr	52.00	200		
198	Mn	54.938	202		
200	Fe	55.85	204		
202	Co	58.93	206		
204	Ni	58.69	208		
206	Cu	63.55	210		
208	Zn	65.39	212		
210	Ga	69.72	214		
212	Ge	72.59	216		
214	As	74.92	218		
216	Se	78.96	220		
218	Br				

§Not yet named

58	Ce	140.12	59	Pr	140.91	60	Nd	144.24	61	Pm	(145)	62	Sm	150.4	63	Eu	151.97	64	Gd	157.25	65	Tb	158.93	66	Dy	162.50	67	Ho	164.93	68	Er	167.26	69	Tm	168.93	70	Yb	173.04	71	Lu	174.97
90	Th	232.04	91	Pa	231.04	92	U	238.03	93	Np	237.05	94	Pu	(244)	95	Am	(243)	96	Cm	(247)	97	Bk	(247)	98	Cf	(251)	99	Es	(252)	100	Fm	(257)	101	Md	(258)	102	No	(259)	103	Lr	(260)

***Lanthanide Series**

† Actinide Series

STANDARD REDUCTION POTENTIALS IN AQUEOUS SOLUTION AT 25°C

Half-reaction		$E^\circ(\text{V})$
$\text{Li}^+ + e^- \rightarrow \text{Li}(s)$		-3.05
$\text{Cs}^+ + e^- \rightarrow \text{Cs}(s)$		-2.92
$\text{K}^+ + e^- \rightarrow \text{K}(s)$		-2.92
$\text{Rb}^+ + e^- \rightarrow \text{Rb}(s)$		-2.92
$\text{Ba}^{2+} + 2 e^- \rightarrow \text{Ba}(s)$		-2.90
$\text{Sr}^{2+} + 2 e^- \rightarrow \text{Sr}(s)$		-2.89
$\text{Ca}^{2+} + 2 e^- \rightarrow \text{Ca}(s)$		-2.87
$\text{Na}^+ + e^- \rightarrow \text{Na}(s)$		-2.71
$\text{Mg}^{2+} + 2 e^- \rightarrow \text{Mg}(s)$		-2.37
$\text{Be}^{2+} + 2 e^- \rightarrow \text{Be}(s)$		-1.70
$\text{Al}^{3+} + 3 e^- \rightarrow \text{Al}(s)$		-1.66
$\text{Mn}^{2+} + 2 e^- \rightarrow \text{Mn}(s)$		-1.18
$\text{Zn}^{2+} + 2 e^- \rightarrow \text{Zn}(s)$		-0.76
$\text{Cr}^{3+} + 3 e^- \rightarrow \text{Cr}(s)$		-0.74
$\text{Fe}^{2+} + 2 e^- \rightarrow \text{Fe}(s)$		-0.44
$\text{Cr}^{3+} + e^- \rightarrow \text{Cr}^{2+}$		-0.41
$\text{Cd}^{2+} + 2 e^- \rightarrow \text{Cd}(s)$		-0.40
$\text{Tl}^+ + e^- \rightarrow \text{Tl}(s)$		-0.34
$\text{Co}^{2+} + 2 e^- \rightarrow \text{Co}(s)$		-0.28
$\text{Ni}^{2+} + 2 e^- \rightarrow \text{Ni}(s)$		-0.25
$\text{Sn}^{2+} + 2 e^- \rightarrow \text{Sn}(s)$		-0.14
$\text{Pb}^{2+} + 2 e^- \rightarrow \text{Pb}(s)$		-0.13
$2 \text{H}^+ + 2 e^- \rightarrow \text{H}_2(g)$		0.00
$\text{S}(s) + 2 \text{H}^+ + 2 e^- \rightarrow \text{H}_2\text{S}(g)$		0.14
$\text{Sn}^{4+} + 2 e^- \rightarrow \text{Sn}^{2+}$		0.15
$\text{Cu}^{2+} + e^- \rightarrow \text{Cu}^+$		0.15
$\text{Cu}^{2+} + 2 e^- \rightarrow \text{Cu}(s)$		0.34
$\text{Cu}^+ + e^- \rightarrow \text{Cu}(s)$		0.52
$\text{I}_2(s) + 2 e^- \rightarrow 2 \text{I}^-$		0.53
$\text{Fe}^{3+} + e^- \rightarrow \text{Fe}^{2+}$		0.77
$\text{Hg}_2^{2+} + 2 e^- \rightarrow 2 \text{Hg}(l)$		0.79
$\text{Ag}^+ + e^- \rightarrow \text{Ag}(s)$		0.80
$\text{Hg}^{2+} + 2 e^- \rightarrow \text{Hg}(l)$		0.85
$2 \text{Hg}^{2+} + 2 e^- \rightarrow \text{Hg}_2^{2+}$		0.92
$\text{Br}_2(l) + 2 e^- \rightarrow 2 \text{Br}^-$		1.07
$\text{O}_2(g) + 4 \text{H}^+ + 4 e^- \rightarrow 2 \text{H}_2\text{O}(l)$		1.23
$\text{Cl}_2(g) + 2 e^- \rightarrow 2 \text{Cl}^-$		1.36
$\text{Au}^{3+} + 3 e^- \rightarrow \text{Au}(s)$		1.50
$\text{Co}^{3+} + e^- \rightarrow \text{Co}^{2+}$		1.82
$\text{F}_2(g) + 2 e^- \rightarrow 2 \text{F}^-$		2.87

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ADVANCED PLACEMENT CHEMISTRY EQUATIONS AND CONSTANTS

ATOMIC STRUCTURE

$$\Delta E = h\nu$$

$$c = \lambda\nu$$

$$\lambda = \frac{h}{mv}$$

$$p = mv$$

$$E_n = \frac{-2.178 \times 10^{-18}}{n^2} \text{ joule}$$

E = energy

ν = frequency

λ = wavelength

p = momentum

v = velocity

n = principal quantum number

m = mass

EQUILIBRIUM

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

$$K_b = \frac{[OH^-][HB^+]}{[B]}$$

$$K_w = [OH^-][H^+] = 1.0 \times 10^{-14} \text{ @ } 25^\circ\text{C}$$

$$= K_a \times K_b$$

$$\text{pH} = -\log [H^+], \text{pOH} = -\log [OH^-]$$

$$14 = \text{pH} + \text{pOH}$$

$$\text{pH} = \text{p}K_a + \log \frac{[A^-]}{[HA]}$$

$$\text{pOH} = \text{p}K_b + \log \frac{[HB^+]}{[B]}$$

$$\text{p}K_a = -\log K_a, \text{p}K_b = -\log K_b$$

$$K_p = K_c(RT)^{\Delta n}$$

where Δn = moles product gas - moles reactant gas

$$\text{Speed of light, } c = 3.0 \times 10^8 \text{ m s}^{-1}$$

$$\text{Planck's constant, } h = 6.63 \times 10^{-34} \text{ J s}$$

$$\text{Boltzmann's constant, } k = 1.38 \times 10^{-23} \text{ J K}^{-1}$$

$$\text{Avogadro's number} = 6.022 \times 10^{23} \text{ molecules mol}^{-1}$$

$$\text{Electron charge, } e = -1.602 \times 10^{-19} \text{ coulomb}$$

$$1 \text{ electron volt per atom} = 96.5 \text{ kJ mol}^{-1}$$

Equilibrium Constants

K_a (weak acid)

K_b (weak base)

K_w (water)

K_p (gas pressure)

K_c (molar concentrations)

S° = standard entropy

H° = standard enthalpy

G° = standard free energy

E° = standard reduction potential

T = temperature

n = moles

m = mass

q = heat

c = specific heat capacity

C_p = molar heat capacity at constant pressure

1 faraday \mathcal{F} = 96,500 coulombs

THERMOCHEMISTRY

$$\Delta S^\circ = \sum S^\circ \text{ products} - \sum S^\circ \text{ reactants}$$

$$\Delta H^\circ = \sum \Delta H_f^\circ \text{ products} - \sum \Delta H_f^\circ \text{ reactants}$$

$$\Delta G^\circ = \sum \Delta G_f^\circ \text{ products} - \sum \Delta G_f^\circ \text{ reactants}$$

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

$$= -RT \ln K = -2.303 RT \log K$$

$$= -n \mathcal{F} E^\circ$$

$$\Delta G = \Delta G^\circ + RT \ln Q = \Delta G^\circ + 2.303 RT \log Q$$

$$q = mc\Delta T$$

$$C_p = \frac{\Delta H}{\Delta T}$$

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GASES, LIQUIDS, AND SOLUTIONS

$$PV = nRT$$

$$\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$$

$$P_A = P_{\text{total}} \times X_A, \text{ where } X_A = \frac{\text{moles A}}{\text{total moles}}$$

$$P_{\text{total}} = P_A + P_B + P_C + \dots$$

$$n = \frac{m}{M}$$

$$K = ^\circ\text{C} + 273$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$D = \frac{m}{V}$$

$$u_{\text{rms}} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3RT}{M}}$$

$$KE \text{ per molecule} = \frac{1}{2} mv^2$$

$$KE \text{ per mole} = \frac{3}{2} RT$$

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

molarity, M = moles solute per liter solution

molality = moles solute per kilogram solvent

$$\Delta T_f = iK_f \times \text{molality}$$

$$\Delta T_b = iK_b \times \text{molality}$$

$$\pi = \frac{nRT}{V} i$$

P = pressure

V = volume

T = temperature

n = number of moles

D = density

m = mass

v = velocity

u_{rms} = root-mean-square speed

KE = kinetic energy

r = rate of effusion

M = molar mass

π = osmotic pressure

i = van't Hoff factor

K_f = molal freezing-point depression constant

K_b = molal boiling-point elevation constant

Q = reaction quotient

I = current (amperes)

q = charge (coulombs)

t = time (seconds)

E° = standard reduction potential

K = equilibrium constant

Gas constant, $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$

$= 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$

$= 8.31 \text{ volt coulomb mol}^{-1} \text{ K}^{-1}$

Boltzmann's constant, $k = 1.38 \times 10^{-23} \text{ J K}^{-1}$

K_f for $\text{H}_2\text{O} = 1.86 \text{ K kg mol}^{-1}$

K_b for $\text{H}_2\text{O} = 0.512 \text{ K kg mol}^{-1}$

STP = 0.000°C and 1.000 atm

Faraday's constant, $\mathcal{F} = 96,500 \text{ coulombs per mole of electrons}$

OXIDATION-REDUCTION; ELECTROCHEMISTRY

$$Q = \frac{[C]^c [D]^d}{[A]^a [B]^b}, \text{ where } a A + b B \rightarrow c C + d D$$

$$I = \frac{q}{t}$$

$$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{RT}{n\mathcal{F}} \ln Q = E_{\text{cell}}^\circ - \frac{0.0592}{n} \log Q @ 25^\circ\text{C}$$

$$\log K = \frac{nE^\circ}{0.0592}$$

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RULES FOR ASSIGNING OXIDATION NUMBERS

RULE 1: The oxidation number of any free element is 0.
Ex: H_2 or P_4

RULE 2: The oxidation number of a monatomic ion (Na^+ , Ca^{+2} , Cl^- , ...) is equal to the charge on the ion.

Note: some ions have multiple oxidation numbers such as Fe^{+2} or $+3$

RULE 3: The oxidation number of each hydrogen ion in most compounds is $+1$.
Note exception: When hydrogen is a hydride, its charge is a -1 .
Ex: Lithium hydride LiH

RULE 4: The oxidation number of each oxygen ion in most compounds is -2 .
Ex: H_2O Hydrogen ion $= +1$, Oxygen ion $= -2$

Note exception: In peroxides, oxygen charge is -1 .
Peroxides take the form X_2O_2 such as sodium peroxide: Na_2O_2

RULE 5: The sum of the oxidation numbers of all the ions in a particle must equal the apparent charge of that particle.
Ex: H_2O a compound $= 0$

ClO_3^- a polyatomic ion $= -1$

RULE 6: In compounds, the elements of Group IA, IIA, and IIIA (except TI) have only one oxidation number which is positive and corresponds to its group number on the periodic table. $+1$, $+2$, and $+3$ respectively.

Charges

State the oxidation number for each of the ions that make up the compound. Don't forget the oxidation rules.

1. BaCl_2
2. MgO
3. SO_2
4. PH_3
5. Al_2O_3
6. H_2SO_4
7. KNO_3
8. AlF_3
9. CaCl_2
10. K_2O
11. AlCl_3
12. Na_2O
13. FeO

Charges

State the oxidation numbers of each ion that makes up each polyatomic ion. Don't forget the oxidation rules.

1. CO_3^{-2}
2. ClO_3^-
3. CrO_4^{-2}
4. CN^-
5. $\text{Cr}_2\text{O}_7^{-2}$
6. HCO_3^-
7. HSO_4^-
8. NO_3^-
9. NO_2^-
10. MnO_4^-
11. PO_4^{-3}
12. SO_4^{-2}
13. SO_3^{-2}
14. OH^-
15. BO_3^{-3}
16. $\text{Fe}(\text{CN})_6^{-3}$
17. $\text{Fe}(\text{CN})_6^{-4}$
18. HPO_4^{-2}
19. NH_4^+

NAMING COMPOUNDS

Three systems of naming: New(Roman Numerals or Stock), Old(Traditional), and Greek.

1. NEW: This system is used when there are more than one positive ion that exists for the positive ion. (All positive ions except those in Groups IA, IIA, IIIA and Ag, Zn, and TI)

Ex: mercury(II) oxide \rightarrow HgO

2. OLD: This system is used for five elements only: Fe, Cu, Pb, Sn, Hg

The lower of the two charges has the ending -ous

The higher of the two charges has the ending -ic

The stem for each is taken from the Latin.

Ex: Fe+2 ferrous

Fe+3 ferric

Cu+1 cuprous

Cu+2 cupric

Pb+2 plumbous

Pb+4 plumbic

Sn+2 stannous

Sn+4 stannic

Hg+1 mercurous

Hg+2 mercuric

Ex: HgO \rightarrow mercuric oxide

SnF₂ \rightarrow stannous fluoride

NOTE: Compounds named the old system can **also** be named the new system

3. GREEK: To use this system, two conditions must hold.

a) The compound must be a binary compound(a compound with only two elements).

b) The positive ion must be located in Groups IVA, VA, VIA or VIIA.

Prefixes are used to name the compound.

1 mono-

2 di-

3 tri-

4 tetra-

5 penta-

6 hexa-

7 hepta-

8 octa-

9 ennea-

10 deca-

Ex: NO nitrogen monoxide (NOTE: mono is **not** used on the positive ion)

CO₂ carbon dioxide

N₂O₃ dinitrogen trioxide

EXTRA INFO ON POLYATOMIC IONS AND NAMING:

per---ate one more oxygen than -ate

---ate \rightarrow MOST COMMON FORM. MEMORIZE THESE: ClO₃⁻, NO₃⁻, CO₃⁻²,

SO₄⁻², PO₄⁻³

---ite one less oxygen than -ate

hypo---ite two less oxygen than -ate

---ide no oxygen

EX: KClO₄ potassium perchlorate

KClO₃ potassium chlorate

KClO₂ potassium chlorite

KClO potassium hypochlorite

KCl potassium chloride

WORKSHEET VI: Quizzes On Formula Writing and Ions and Their Charge(s)

1. Student Name _____ Class _____

2. Student Name _____ Class _____

Element or ion	Symbol or formula	Number and kind of charge
1. aluminum	_____	_____
2. ammonium	_____	_____
3. antimony	_____	_____
4. barium	_____	_____
5. bromide	_____	_____
6. calcium	_____	_____
7. carbonate	_____	_____
8. chloride	_____	_____
9. copper(II)	_____	_____
10. fluoride	_____	_____
11. hydrogen carbonate	_____	_____
12. hydronium	_____	_____
13. hydroxide	_____	_____
14. iron(II)	_____	_____
15. iron(III)	_____	_____
16. mercury(I)	_____	_____
17. hydride	_____	_____
18. mercury(II)	_____	_____
19. lead	_____	_____
20. nitrate	_____	_____
21. oxide	_____	_____
22. phosphate	_____	_____
23. potassium	_____	_____
24. sulfide	_____	_____
25. sodium	_____	_____
26. sulfate	_____	_____
27. silver	_____	_____
28. zinc	_____	_____

Corrected by _____

	Formulas
1. sodium chloride	_____
2. ammonium hydroxide	_____
3. calcium sulfate	_____
4. magnesium nitrate	_____
5. aluminum phosphate	_____
6. zinc chloride	_____
7. mercury(II) oxide	_____
8. aluminum sulfate	_____
9. silver nitrate	_____
10. barium hydroxide	_____
11. potassium sulfide	_____
12. iron(II) sulfate	_____
13. mercury(I) chloride	_____
14. copper carbonate	_____
15. calcium acetate	_____
16. iron(III) sulfate	_____
17. calcium phosphate	_____
18. zinc sulfide	_____
19. ammonium carbonate	_____
20. antimony chloride	_____
21. potassium oxide	_____
22. ammonium sulfide	_____
23. mercuric nitrate	_____
24. iron(III) chloride	_____
25. aluminum oxide	_____

Corrected by _____

Chem I

Naming and Formula Writing #1

NAME	FORMULA
1. NaOH	1. sodium carbonate
2. NH ₄ Cl	2. aluminum chlorate
3. MgCrO ₄	3. magnesium nitrite
4. CaCO ₃	4. ammonium chloride
5. FeI ₂	5. ferrous bicarbonate
6. Cu ₂ O	6. carbon tetrafluoride
7. SnCl ₄	7. silver nitrate
8. Al(NO ₃) ₃	8. cobalt(II) phosphite
9. CCl ₄	9. mercury(II) sulfide
10. P ₂ O ₅	10. sulfur dioxide
11. Na ₂ PO ₄	11. cuprous hydroxide
12. HClO ₃	12. zinc nitride
13. Hg ₂ SO ₄	13. potassium nitride
14. Pb(C ₂ H ₃ O ₂) ₂	14. plumbous fluoride
15. CO ₂	15. lithium phosphate
16. (NH ₄) ₃ N	16. arsenic(V) oxide
17. Na ₂ P	17. nickel(II) sulfate
18. CO	18. calcium carbonate
19. MgF ₂	19. lithium nitrate
20. CuCl	20. potassium phosphate
21. K ₃ N	21. aluminum fluoride
22. NiSO ₄	22. sodium oxide

Naming and Formula Writing #2

NAME

1. $\text{Cr}(\text{ClO}_3)_3$
2. BaSO_3
3. $\text{Fe}(\text{NO}_3)_2$
4. CaO
5. CoPO_4
6. CuCr_2O_7
7. FeBr_3
8. $\text{Zn}(\text{OH})_2$
9. HgCO_3
10. NaCl
11. FeSO_4
12. CO_2
13. AgNO_3
14. PbF_4
15. SO_2
16. P_2O_5
17. $\text{Ba}(\text{ClO}_3)_2$
18. Cr_2O_3
19. NO
20. Li_2CO_3

FORMULA

1. ferrous chlorate
2. plumbic acetate
3. barium phosphite
4. zinc chromate
5. copper(I) sulfate
6. copper(II) sulfate
7. calcium hydroxide
8. potassium permanganate
9. iron(III) oxide
10. iron(II) oxide
11. sodium chlorate
12. aluminum chloride
13. cuprous carbonate
14. carbon monoxide
15. lithium fluoride
16. barium phosphate
17. diphosphorous trioxide
18. nickel(II) bromide
19. zinc nitrate
20. magnesium nitride

Harder Naming and Formula Writing#1

FORMULA

1. calcium chloride
2. calcium carbonate
3. sodium cyanide
4. magnesium oxide
5. sodium fluoride
6. aluminum chloride
7. silicon(IV) oxide
8. zinc iodide
9. cobalt(II) carbonate
10. potassium hydride
11. copper(II) carbonate
12. potassium hydroxide

13. calcium iodide
14. potassium fluoride
15. calcium hydroxide
16. bismuth sulfate
17. magnesium phosphate
18. mercury(II) cyanide
19. potassium nitrate
20. sodium hydroxide
21. lead(II) nitrate
22. zinc sulfate
23. sodium sulfide
24. iron(III) chloride

NAME

1. BaCl_2
2. $\text{Zn}(\text{NO}_3)_2$
3. $\text{CsC}_2\text{H}_3\text{O}_2$
4. H_2S
5. K_2CO_3
6. FeCl_2
7. $\text{Al}(\text{NO}_3)_3$
8. $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$
9. $\text{Ba}(\text{OH})_2$
10. $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$
11. KCl
12. KBr
13. KI
14. $\text{Ca}(\text{NO}_3)_2$
15. HgI_2

16. $\text{Cu}(\text{NO}_3)_2$
17. P_2O_5
18. PCl_5
19. SF_6
20. PCl_3
21. NH_4NO_3
22. Na_2SO_4
23. Na_2O
24. Na_3PO_4
25. NH_4Cl
26. NaCl
27. Na_2SO_3
28. SnCrO_4
29. K_2CO_3
30. $\text{Hg}_2(\text{NO}_3)_2$

Harder Naming and Formula Writing#1

FORMULA

1. calcium chloride
2. calcium carbonate
3. sodium cyanide
4. magnesium oxide
5. sodium fluoride
6. aluminum chloride
7. silicon(IV) oxide
8. zinc iodide
9. cobalt(II) carbonate
10. potassium hydride
11. copper(II) carbonate
12. potassium hydroxide

13. calcium iodide
14. potassium fluoride
15. calcium hydroxide
16. bismuth sulfate
17. magnesium phosphate
18. mercury(II) cyanide
19. potassium nitrate
20. sodium hydroxide
21. lead(II) nitrate
22. zinc sulfate
23. sodium sulfide
24. iron(III) chloride

NAME

1. BaCl_2
2. $\text{Zn}(\text{NO}_3)_2$
3. $\text{CsC}_2\text{H}_3\text{O}_2$
4. H_2S
5. K_2CO_3
6. FeCl_2
7. $\text{Al}(\text{NO}_3)_3$
8. $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$
9. $\text{Ba}(\text{OH})_2$
10. $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$
11. KCl
12. KBr
13. KI
14. $\text{Ca}(\text{NO}_3)_2$
15. HgI_2

16. $\text{Cu}(\text{NO}_3)_2$
17. P_2O_5
18. PCl_5
19. SF_6
20. PCl_3
21. NH_4NO_3
22. Na_2SO_4
23. Na_2O
24. Na_3PO_4
25. NH_4Cl
26. NaCl
27. Na_2SO_3
28. SnCrO_4
29. K_2CO_3
30. $\text{Hg}_2(\text{NO}_3)_2$